THE IMPROVED METHOD FOR ESTIMATING HIDDEN MARKER POSITIONS DURING INGRESS MOTION

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INTRODUCTION

While safety-related matters like crash tests were important factors in interpreting and evaluating the relationship between vehicles and human beings in past vehicle design, factors such as convenience or comfort of passengers have recently emerged as critical standards in designing and selecting vehicles. Accordingly, the consideration of convenience has become necessary from the early stage of product design. The shape and size of vehicle doors affect comfort in ingress and egress motions of driver, and the human body analysis using motion capture data of the real ingress and egress can be useful for the more ergonomic design.

Unlike the motion analysis on walking or using simple tools, however, the primary markers on a human body are interfered by car frame, seats, etc., when the motion capture is performed on the vehicle ingress and egress motions. Even though adjustment methods using interpolation and so forth have often been introduced where marker positions of part frames are missing during the process of motion capture, the problem involving the marker positions completely covered by seats cannot be resolved by these methods. This paper suggests a method to estimate the positions of markers hidden by vehicle seats among the existing markers by attaching additional markers to a human body..

METHODS

The integral part of the method suggested in this study is estimating positions of markers by forming a local coordinate system for a human body using redundancy markers and calculating coordinates of hidden markers in the system. To achieve this, two-staged experiments were conducted: the first is identifying the right positions for redundancy markers so as to more precisely calculate the positions of hidden markers hidden, and the second, based on the result of the first experiment, simulating and calculating the real positions of markers hidden markers. Selected as the research targets are three markers: T10, R_BAK, and SACRAL, which are hidden when seated in a vehicle (Figure 1).

RESULTS AND DISCUSSION

The three redundancy markers were respectively attached to the both sides and the center of sterna to trace the three target markers (Figure 1), and the mean coordinates and the standard deviations in local coordinate system were calculated through walking and sitting experiments (Table 1). Based on the result, the vehicle ingress motion was simulated with three redundancy markers on the center of sterna, and two on the pelvis in the final simulation.

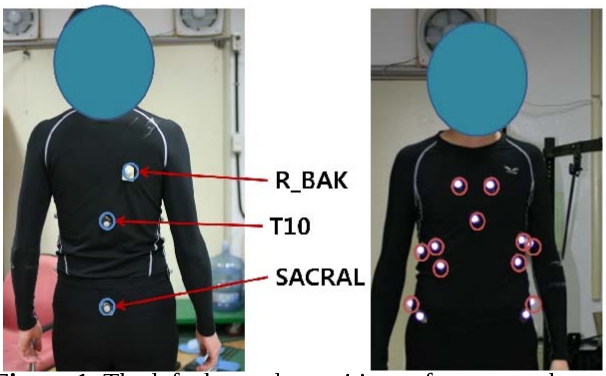

Figure 1: The left shows the positions of target markers, and red ones on the right show the positions of additional markers to estimate their location.

CONCLUSIONS

Because data on markers cannot be gathered from the moment right before the buttocks and back touch a vehicle seat in the original data obtained through motion capture, only the analysis on frames before that moment could be interpreted. However, simulation and analysis on the whole ingress and egress motions are possible by estimating the positions of hidden markers through the suggested method.

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Table 1: Standard deviations when the positions of target markers are estimated according to those of redundancy markers.

Standard Deviation	Experiment Case					
(R_BAK / T10)	Walking 1	Walking 2	Walking 3	Sitting 1	Sitting 2	Sitting 3
Left Sterna	87.33 / 66.37	17.47 / 13.01	28.70 / 25.43	41.34 / 30.32	71.27 / 43.79	46.69 / 33.57
Right Sterna	10.99 / 11.38	21.06 / 23.49	8.32 / 11.03	30.12 / 40.68	30.30 / 39.60	28.78 / 32.81
Center of Sterna	4.72 / 8.55	3.87 / 8.05	3.57 / 7.86	18.23 / 20.61	16.28 / 18.63	7.70 / 8.92